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GUIDELINE A-7

**Combustion and Air Pollution Control Requirements
for New Municipal Waste Incinerators**

December 1995

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Ontario

Ministry of Environment and Energy

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SYNOPSIS

This guideline applies to new publicly or privately-owned incinerator systems designed to burn municipal waste and was developed on the basis of "Maximum Achievable Control Technology," human health considerations and the approaches taken by other jurisdictions. For the purposes of this guideline, municipal waste means any waste, including solid fuel derived from waste, whether or not it is owned, controlled or managed by a municipality, except hazardous waste, liquid industrial waste or gaseous waste.

The guideline will be applied through conditions on certificates of approval in accordance with the requirements of the *Environmental Protection Act*, Part V, Section 27, and Part II, Section 9.

The requirements of this guideline supersede those of Guideline A-1 for municipal waste incinerators. However, it should be noted that this guideline does not apply to biomedical waste incinerators, sewage sludge incinerators or woodwaste incinerators. Those facilities are subject to the Ministry's regulation requirements and any guideline developed specifically for those types of facilities.

This guideline does not apply to existing incinerators but will apply to the expansion or modification of existing incinerators.

The guideline reflects the installation of air pollution control systems, sets air emission limits for particulate matter, acid gases, metals and dioxins/furans and establishes requirements for the control, monitoring and performance testing of incineration systems.

Emission limits specified in this guideline will be reviewed and updated by the Ministry to reflect technology improvements and new health and environmental information.

1.0 INTRODUCTION

This guideline establishes minimum design and operating parameters, emission control systems and emission limits which will ensure control of emissions to the atmosphere from municipal waste incinerators.

This guideline applies to all new, expanded or modified incinerators burning municipal waste except those which burn sewage sludge or woodwaste either exclusively or in combination with conventional fossil fuel.

The requirements specified in this guideline are in addition to those in Ontario Regulation 346 (RRO 1990), General -- Air Pollution, including compliance with the point of impingement standards prescribed in Schedule 1 to that regulation and the concentration of organic matter limit in Section 12.

The limits in this guideline for cadmium, lead, mercury, particulate matter and acid gases are technology based, using the maximum achievable control technology (MACT) principle. In all cases, the limits are below those that would be established based solely on protection of human health and the environment. The Ministry will also ensure protection of human health and the environment by also using Ontario Regulation 346 and associated Ministry policies containing point of impingement limits during the evaluation of new municipal waste incinerator proposals.

2.0 DEFINITIONS

Burner Flame Front:

The visible luminous front zone of the flame, formed by the burner, in which intense localized gas phase combustion occurs.

Combustion Air:

The air supplied to the incinerator for the burning of the waste and/or the fuel.

Feed Rate:

The weight of waste introduced or fed into the incinerator per unit time.

Gas-Phase Turbulence:

Turbulence in the combustion gases, denoting an irregular fluctuation (i.e. mixing and eddying) superimposed on the main stream. Good mixing of the products of

incomplete combustion (primarily carbon monoxide and hydrocarbons) and of the combustion air is promoted by a highly turbulent flow of the gases.

Negative Pressure:

A pressure that is less than ambient pressure.

Operating Parameters:

The variables of the incinerator process and waste stream used to control the operation of the incinerator. These include: the waste feed rate, composition, and heating value; combustion air feed rate(s); and heat production and losses.

Reference flue gas conditions:

Reference flue gas conditions are defined as follows:

- Temperature 25°C
- Pressure 101.3 kPa
- Oxygen content 11 %
- Water content nil (dry conditions)

3.0 ABBREVIATIONS

HCl	hydrogen chloride or hydrochloric acid
I-TEQ	international toxic equivalents measurement for dioxins and furans
kPa	kilopascals
mg/Rm ³	milligrams per reference cubic metre
ng/Rm ³	nanograms per reference cubic metre
O ₂	oxygen
ppmv	parts per million by volume
R	reference conditions
SO ₂	sulphur dioxide
µg/Rm ³	micrograms per reference cubic metre

4.0 GUIDELINE REQUIREMENTS

4.1 Combustion in Incinerators

This section sets out the design and operating requirements to achieve good combustion conditions in municipal waste incinerators. Minimum design and operating parameters for incinerator temperature, residence time and combustion air distribution have been established to provide guidance to proponents in designing an incineration system that will achieve high combustion efficiencies. However, it should be emphasized that these requirements are not intended to restrict design technology. The Ministry will consider alternative incineration systems for approval provided that they are designed and operated to achieve a high level of combustion efficiency.

The Ministry will evaluate the design and operating parameters of incinerators when reviewing an application for approval. Detailed engineering drawings, specifications and calculations to support the design and operating parameters must be submitted in all cases regardless of the type of incineration system being proposed.

4.1.1 Incineration Temperature

Incinerators shall be capable of maintaining, on a continuous basis, an incineration temperature of at least 1100°C, and shall operate at a temperature of not less than 1000°C. They shall incorporate an auxiliary burner to provide this minimum operating temperature:

- at start-up before the commencement of the incineration cycle;
- during shutdown until all combustion of waste has ceased; and
- when necessary during other phases of operation.

4.1.2 Combustion Air Distribution

Primary and secondary combustion air systems for incinerators shall be designed to control air distribution. Control systems shall provide the capability to adjust the distribution of combustion air and to automatically adjust the quantity of combustion air to respond to the range of waste properties, incinerator feed rates, and irregularities in loading and/or burning patterns in the incinerator.

4.1.3 Residence Time

Incinerators shall be designed for a combustion gas residence time of not less than one second at 1000°C. This residence time shall be calculated from the

point where most of the combustion has been completed and the incineration temperature has fully developed.

(a) Multi-chamber Incinerators

In multi-chamber incinerators, the residence time shall be calculated from the secondary burner(s) flame front. If air is introduced downstream of the burner flame front, residence time shall be calculated from the final air injection point.

(b) Single-chamber Incinerators

Where the furnace is one continuous space, such as in "spreader stoker" and "single chamber mass burning" designs, the location of the complete combustion/fully developed temperature point shall be determined by an overall design review, and may be significantly downstream of the final air injection point.

4.1.4 Oxygen Availability

The lack of sufficient oxygen in the flue gases leaving the incinerator is an indicator of incomplete combustion and is a contributing factor to the discharge of volatile organic compounds. Incinerators shall be designed and operated to ensure that sufficient residual oxygen has been provided in the flue gas exhaust to minimize the discharge of products of incomplete combustion during the entire incineration cycle.

The requirements in this section are in addition to the concentration of organic matter limit in Section 12 of Ontario Regulation 346.

4.1.5 Turbulence and Mixing

Incinerators shall be designed to provide and maintain a high degree of gas phase turbulence and mixing in the secondary combustion zone. Provisions shall include any combination of: appropriately located/directed air jets, changes of flue gas flow direction, baffling, and constriction of cross-sectional flue gas flow area.

4.1.6 Range of Operation

Incinerators shall be designed to achieve the temperature, residence time, oxygen availability and turbulence requirements of this guideline over the entire expected range of values of the incinerator operating parameters, including:

- feed rate (including minimum and maximum rates);
- ultimate analysis, heating value, ash and moisture content of the waste;
- combustion air; and
- heat losses.

4.1.7 Pressure Control and Emergency Exhaust

Incinerators shall be designed to operate under negative pressure during all phases of operation. If an emergency exhaust is provided, its location and operation shall be specified as a condition to a certificate of approval.

4.1.8 Control and Monitoring Systems

Incinerators shall incorporate control and monitoring systems to ensure, readily indicate and confirm that the requirements of this guideline, as well as other Ministry standards, regulations and guidelines, are consistently met. Control and monitoring systems shall be capable of readily signifying and correcting any aspect of a substandard operation.

4.1.9 Continuous Monitoring Parameters

Continuously monitored parameters shall include temperature(s), total hydrocarbons (or carbon monoxide), nitrogen oxides and opacity. Based on design, operating conditions and waste feed, monitoring may also be required for residual oxygen, carbon dioxide, incinerator exhaust flue gas volume, hydrogen chloride, sulphur oxides, and other parameters. Continuous monitors shall be equipped with recording devices for subsequent reference and analysis and shall correspond to the provisions of the Environment Canada document "Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation" (Report EPS 1/PG/7, September 1993) or some equivalent specification approved by the Director of the Ministry's Approvals Branch.

4.1.10 Organic Content of Ash

The incinerator operation shall be controlled such that the organic content of the bottom ash shall not exceed 5% by weight.

4.2 Air Pollution Controls For Incinerators

The requirements listed in 4.2.1 through 4.2.8 including emission limits will be reviewed and updated by the Ministry to reflect technology improvements and new health and environmental information.

4.2.1 Particulate Outlet Concentration

Air pollution control systems for incinerators shall achieve a maximum outlet particulate loading of not greater than 17 mg/Rm^3 .

For cement and lime kilns burning municipal waste, a site specific limit for particulate shall be established and incorporated into a certificate of approval. The site specific limit shall be a weighted average of the above limit for particulate from a municipal waste incinerator and the limit currently used for operation with conventional fuel. The weighting shall be based on the relative amounts of flue gas attributable to municipal waste combustion and conventional fuel combustion.

4.2.2 Heavy Metal Concentrations

Air pollution control systems for incinerators shall achieve a maximum outlet concentration for heavy metals as follows:

for cadmium	--	$14 \text{ } \mu\text{g/Rm}^3$
for lead	--	$142 \text{ } \mu\text{g/Rm}^3$
for mercury	--	$57 \text{ } \mu\text{g/Rm}^3$

For cement and lime kilns burning municipal waste, the heavy metal concentration requirements of this section shall apply unless the concentration of a specific heavy metal in the process raw materials (excluding fuel) fed to the kiln is such that the relevant limit would be exceeded. In such a case, site specific limits for metals may be established and incorporated into a certificate of approval.

4.2.3 Dioxin/Furan Concentration

Air pollution control systems for incinerators shall achieve a maximum outlet concentration of dioxins and furans, expressed as 2,3,7,8-TCDD toxicity equivalents according to the international toxicity equivalent factor method adopted by Canada in 1990, of $0.14 \text{ ng I-TEQ/Rm}^3$.

4.2.4 Hydrochloric Acid (HCl) and Sulphur Dioxide (SO₂) Concentration and Removal

Air pollution control systems for incinerators shall achieve either an HCl removal efficiency of not less than 95%, or a maximum guaranteed HCl outlet concentration of 18 ppmv (at 11% O₂ dry) based on the average of three 1-hour tests. This is equivalent to 27 mg/Rm³ HCl.

Air pollution control systems for incinerators shall also achieve a maximum SO₂ outlet concentration of 21 ppmv (at 11% O₂ dry) based on the geometric average of 24 hours of data from a continuous emission monitoring system. This is equivalent to 56 mg/Rm³ SO₂.

For cement and lime kilns burning municipal waste, a site specific limit for SO₂ shall be established based on the concentration of SO₂ in the stack gases when burning conventional fuels and shall be incorporated into a certificate of approval.

4.2.5 Nitrogen Oxides (NO_x) Concentration

Air pollution control systems for incinerators shall achieve a maximum NO_x outlet concentration of 110 ppmv (at 11% O₂, dry) based on the arithmetic average of 24 hours of data from a continuous emission monitoring system.

For cement and lime kiln operators wishing to seek approval to add municipal waste to their current fuel stream, a site specific NO_x emission limit will be set and written into the conditions of approval based on NO_x concentrations when burning conventional fuels. This will prevent any increase in NO_x emissions and may well see a decrease as the fuel stream is augmented. The Ministry will continue to monitor the development of NO_x control technology worldwide and, as proven technology is developed, this guideline will be reviewed.

4.2.6 Organic Matter Concentration

In addition to the requirements of this guideline, the requirements of Section 12 (2) of Ontario Regulation 346 must be met. This section requires that the organic matter emissions from an incinerator have a carbon content expressed as equivalent methane not greater than 100 ppmv measured on an undiluted basis.

4.2.7 Continuous Operation

Air pollution control systems for incinerators shall be designed to operate on a continuous basis, as much as possible, whenever there is waste burning in the incinerator. The design of the system shall incorporate consideration of:

- the conditions which could lead to an unscheduled shutdown of the air pollution control system;
- means of ameliorating such conditions; and
- air pollution control bypassing which cannot be avoided.

The incinerator system controls shall be designed to ensure the shutdown of the incinerator immediately upon an unscheduled shutdown of the air pollution control system in a manner that will minimize air emissions. The control system shall also be designed to record pertinent information for subsequent reporting to the local District Office of the Ministry, and for an assessment of the reasons for the shutdown and potential measures to prevent a recurrence.

4.2.8 Performance Tests

The Director of the Ministry's Approvals Branch will determine the frequency of performance tests.

The removal efficiency and/or outlet loadings as described above in sections 4.2.1 to 4.2.4 shall be demonstrated by performance test programs approved by the Science and Technology Branch and, where applicable, by methods included in the Source Testing Code (Procedure A-1-1). Continuous emission monitoring system results shall be correlated to the stack sampling results.

Performance tests shall be undertaken within six months of start-up and, thereafter, at a frequency of at least once a year or more often as determined by the Director. The performance test results shall be used to define the acceptable range of feed rates, operating procedures and range of readings for continuous monitoring devices. Any exceedance of the acceptable range for any monitor shall be reported to the local District Office of the Ministry.

4.3 Ash Management

Under Ontario Regulation 347, fly ash from the incinerator's energy recovery and pollution control system must be handled separately from the burning zone's bottom ash. Fly ash must be tested for leachate toxicity if the operator wants to classify the ash as non-hazardous. The Ministry's testing protocol for leachate toxicity is contained in Ontario Regulation 347 while the sampling procedure and

results evaluation procedure is in the Ministry's policy publication "Protocol for Sampling and Evaluating Fly Ash from Non-Hazardous Solid Waste Incineration Facilities".

Incinerator operators shall analyze bottom and fly ashes sent to disposal for leachate toxicity and ultimate analysis during performance tests or at the direction of the Director of the Ministry's Approvals Branch.

4.4 Other Industrial Processes Burning Municipal Waste

This guideline will apply to other industrial processes burning municipal waste which have not been specified above; however, where it can be demonstrated that the limits in this guideline are not consistent with the principle of maximum achievable control technology for an industrial process, industry may apply to the Ministry for revised limits.

4.5 Reports

The incinerator operator shall report in writing to the Ministry's local District Office within 30 days of an occurrence of an unscheduled shutdown of the air pollution control system setting out the reasons for the shutdown and the measures that have been taken to prevent a recurrence.

The incinerator operator shall provide a written report to the Ministry on the results of the performance tests carried out in conformance with section 4.2.8 of this guideline and shall also make it available to the public. The incinerator operator shall also provide a plain-English summary report of the results of the performance tests for general public distribution.

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